

Executive Summary



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Introduction

This report assesses the environmental performance and related impacts of California’s electric generation facilities, and responds to certain directives contained in Senate Bill (SB) 110, as enacted into law in 1999 (Cal. Stats. 1999, Chapter 581). Specifically, commencing July 1, 2001 and biennially thereafter, Public Resources Code Section 25309.3 (c) requires the California Energy Commission (Energy Commission) to report to the Governor and the Legislature concerning the following:

- The current status and historical trends in the environmental performance of California’s electric generating facilities, including generation efficiency and air pollution control technologies in use;
- The geographic distribution of environmental impacts from electric facilities, including impacts to air quality, water resources, and wildlife habitat, and the geographic distribution of related socioeconomic benefits and drawbacks; and
- The extent to which the operation of existing electric generation facilities, and related environmental performance and impacts, could be displaced or reduced by new electric generation facilities. (As required by statute, subsequent biennial reports will assess the extent to which displacement or reduced operations of the existing electric generation facilities has actually occurred.)

California’s electricity supply system is comprised of a wide range of generating facilities located throughout the state, the western region of the United States, and in Canada and Mexico as well. This initial report will focus only on the environmental performance and related impacts of California’s in-state electric generation facilities.

During the first three decades of the 20th century, hydroelectric power plants were the state’s main source of electricity. Hydroelectric development continued in all decades, peaking in the 1960s. Oil-fired power plant development began in the late 1930s and peaked in the 1950s and 1960s. The oil shortage and air quality concerns of the 1970s caused these plants to switch to natural gas (keeping oil as a back up fuel to use when gas supplies were short).

A few nuclear power plants were added to California’s utility system beginning in the late 1960s through the 1980s. Policies to increase the diversity of primary energy sources for electricity generation in the 1970s and 1980s led to the development of geothermal, wind, waste-to-energy, and solar energy facilities as well as cogeneration plants fueled by natural gas and coal.

Post-1996 power plant development in California has consisted almost exclusively of natural gas-fired simple-cycle combustion turbine power plants and combined-cycle combustion turbine facilities, including the expansion or repowering of older thermal power plants.

Key Findings

The electric generation system’s efficiency and environmental performance have improved significantly. This improvement has been due to the increased use of renewable generation technologies, fuel switching from oil to natural gas, and more efficient fuel combustion and environmental control technologies.

Although older facilities have been displaced as the electric system has expanded, it is difficult to predict when, where, and to what extent individual facilities will be displaced in the future, because of market conditions, weather, and other factors.

The state’s power plants continue to provide a critical service which supports our economy and standard of living without adversely affecting the socioeconomic and demographic characteristics of local communities.

Below are the key findings of this report, followed by recommended topics for future biennial reports.

Thermal Efficiency of Oil/Gas Electric Generation

- The thermal efficiency of fossil-fueled generation technologies has improved significantly over the past 50 years, from less than 30 percent to as much as 53 percent. (Efficiency is expressed in higher heating value to enable comparisons between fossil-fueled technologies.) The most advanced gas turbines in a combined-cycle application have achieved a slightly higher efficiency — 54.1 percent. These new power plants may be nearing their thermodynamic limits of efficiency.

Air Resources

- Air pollution control technologies used for power plant emissions have improved significantly over the past 25 years. For example, retrofitting existing power plants with new controls may reduce oxides of nitrogen (NOx) emissions by up to 90 percent.
- The total air pollutant emissions from in-state fossil-fueled power plants has decreased significantly over the last 25 years. For example, the total annual NOx emissions from power plants in California has declined from 385 tons per day in 1975 to 79 tons per day in 2000.
- Strategies to improve local air quality, however, will continue to consider power plant emissions.
- The majority of California’s power plants are located in the state’s most severely polluted areas, South Coast and San Joaquin Valley; or most densely populated areas, San Francisco Bay Area and San Diego County.

Water Resources

- Competition for the state’s limited fresh water supplies is increasing and demand may exceed supply by 2020.

- The amount of water used by power plants is less than one percent of total statewide water demand. Impacts to limited local water supplies from individual power plants, however, can be significant.
- Existing coastal or bay side steam-boiler power plants, which use once-through cooling, are being expanded, repowered, or replaced with more efficient combined-cycle facilities. These new power plants use 50 percent less cooling water per megawatt hour for once-through cooling than the old steam-boiler plants.
- No new power plants using once-through cooling have been proposed at coastal or bay side sites.
- New power plants are increasingly being sited away from the coast, in areas where fresh water supplies are limited.
- The increased demand for fresh water supplies by California’s growing population has lead to a decline in fresh water available for use by new power plants. In response, new power plants have increased their use of alternative water supplies and dry-cooling technology.
- Improved wastewater treatment and disposal methods are reducing the adverse impacts of power generation on water quality. These improvements are due to reduced volumes of wastewater discharge and to improved wastewater quality.

Biological Resources

- The primary biological impacts from electrical generation development in California have been loss of terrestrial habitats and loss and alteration of aquatic habitats.
- Many hydroelectric and thermal power plants built prior to the adoption of environmental laws caused significant loss of and damage to sensitive terrestrial and aquatic habitats in the mountainous and coastal areas of the state.
- New simple-cycle and combined-cycle power plants cause less biological damage than older power plants, because they use much less land and are not typically sited in sensitive biological resource areas.
- The damage to aquatic biological resources continues at coastal power plant sites using once-through cooling, and at many hydroelectric facilities due to altered stream flows.
- Repowering or expanding power plants at existing coastal and bay side sites will perpetuate significant impacts on aquatic ecosystems through the continued use of once-through cooling water systems. Impacts on a megawatt hour basis, however, will be reduced due to the use of more efficient power plants.
- Existing and proposed power plants in the southwestern oil fields of San Joaquin Valley have caused and will continue to cause significant cumulative impacts to biological resources due to habitat loss. These impacts are mitigated in part by off-site habitat preservation programs.

- With the exception of hydroelectric generation, power plant impacts on biological resources are much less significant than impacts from urban, suburban, transportation, and agricultural development.

Socioeconomic Impacts

- A reliable and affordable electricity supply supports economic development and helps maintain the state’s high standard of living.
- Southern California and the San Francisco Bay Area counties generate and consume the most electricity within the state.
- Electric generation facilities are valued for the electrical services they provide and their contributions to local tax revenues, particularly property tax revenues.
- Property tax revenues from merchant plants are paid only to the municipal jurisdiction in which they are located. Property tax revenues from utility-owned generations are distributed to multiple jurisdictions within a county.
- New electric generation facilities do not adversely impact local public services if these impacts are mitigated.
- Large power plant construction, although short-term, provides a significant number of local jobs (a peak workforce of approximately 250). Employment at new operating power plants will not be a significant economic benefit (approximately 25 jobs per new combined-cycle power plant).
- An analysis of communities near 13 major power plant sites did not reveal any significant differences in socioeconomic characteristics compared to communities in the same vicinity without power plants. Although the 13 communities changed their demographic and socioeconomic characteristics over time, the communities did not become predominantly minority or low-income populations.
- Socioeconomic benefits of electric generation facilities substantially outweigh their socioeconomic drawbacks when considered from a regional or statewide perspective.
- The Energy Commission has identified no significant disproportionate environmental justice impacts in any of the power plant projects it has approved since 1998.

Displacement

- Over time, older and less-efficient power plants have been displaced or have reduced their operations.
- The displacement of specific facilities in the future cannot be predicted with any certainty due to various factors, including rainfall, temperature, and market conditions, all of which will significantly influence how the electricity system is operated day-to-day.

Recommendations for Next Biennial Report

Some aspects of the state’s electricity generation system, or critical factors that may affect it, were not fully considered in this report. The following is a preliminary list of topics that should be addressed in the next biennial Environmental Performance Report.

- Questions have been raised regarding whether California’s current electricity “crisis” may alter or delay the positive environmental trends noted in this report. The next report will evaluate the consequences (particularly air quality, water quality, and water supply) resulting from existing power plant operations and from constructing new power plant facilities during this “crisis” period.
- The improved collection of operating and environmental performance data for individual power plants is needed to conduct future assessments of the state’s electricity generating system.
- The next report may address other aspects of the state’s electricity supply system, such as transmission and gas pipeline infrastructure.

Air Resource Analysis

- Future assessments should address air quality impacts from distributed generation, including diesel-fired back up generators.
- The effect of power plant emissions on the new standard for particulate matter less than 2.5 microns in diameter should be evaluated.

Water Resource Analysis

- An evaluation is needed of the effects of using alternatives to fresh water cooling — including reclaimed water and dry-cooling — upon power plant thermal efficiency.

Biological Resource Analysis

- The cumulative biological resource impacts should be evaluated for the rapidly growing wind generation sector, small hydroelectric facilities, and thermal plants relying on once-through cooling.
- The watershed effects on biological resources from hydroelectric facilities need to be assessed for the large number of hydroelectric projects proposed for relicensing this decade.

Socioeconomic Impacts Analysis

- The socioeconomic impact assessment in this initial report focused on California’s oldest and largest fossil-fueled power plants. The next report should also assess the impacts from hydroelectric facilities, particularly those in rural counties, as well as recently constructed peaking power plants.
- The next report should assess whether market mechanisms, such as air quality offset trading, are resulting in an inequitable allocation of limited natural resources with regard to regional economic development.